PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1952-53

TANGANYIKA TERRITORY
LAKE PROVINCE

PUBLISHED BY
THE EMPIRE COTTON GROWING CORPORATION,
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.

1954

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TANGANYIKA TERRITORY.
LAKE PROVINCE.

PROGRESS REPORT FOR THE SEASON 1952-53.

BY

J. E. PEAT, J. M. MUNRO AND M. H. ARNOLD.

COTTON SEASON.

Planting: Ukiriguru, 19th November 1952-19th December 1952.
Lubaga, 24th November 1952-23rd January 1953.
Cultivators, November 1952-February 1953.

Picking: April until August.

Legal uprooting date: 15th September 1953.
[Geita District—1st September 1953.]

Rainfall for the period 1st October 1952 to 30th June 1953.
Ukiriguru: 19·25 inches.
Lubaga: 20·20 inches.

INTRODUCTION.

Ukiriguru Station.

Meteorology.—In contrast to the previous season, the rainfall for 1952-53 was the poorest since these records were started. The early planting rains were very patchy. Following some good showers in early January, the seven weeks' period until the end of February was dry. The rains from the beginning of March into May were good. But taken all over it was a very difficult, droughty season.

Staff.—Mr. J. E. Peat was on vacation leave from the end of June until early December 1953. In January 1953, he attended a meeting in Nairobi of the East African Advisory Council on Agriculture, Animal Industry and Forestry, in place of Dr. J. B. Hutchinson who was on leave; and, in February 1953, a conference in Nairobi on Crop Responses to Fertilisers and Manures, at which he presented a paper "Fertiliser Responses—Ukiriguru." On his way back from vacation leave, in early December 1953, he attended the Namulonge Advisory Board Meeting.

Mr. D. Lawes, while on an E.C.G.C. studentship, worked for six weeks at Ukiriguru.

Mr. H. Doggett, Botanist of the Department of Agriculture, is responsible for the all-important food crop work at Ukiriguru, mainly sorghum breeding. The association with him has always been a most pleasant one.

During the season Mr. R. A. Brown, Field Officer (Agriculture), and his assistants, Mr. A. D. P. Angelini, Junior Field Officer, and Mr. I. S. Mkwawa, Assistant Agricultural Officer, have most ably coped with the greater part of the routine Station running.

Mr. James Bushiri, Senior Clerk, after 25 years in Government service, of which 12 years have been spent in charge of the Ukiriguru Station office, is about to retire. During Mr. May's visit he was presented with a clock in appreciation of his services at Ukiriguru.

Visitors.—Ukiriguru was visited by His Excellency the Governor, Sir Edward Twining, and Lady Twining in March 1953, by Sir Frank Engledow in December 1952, and by Dr. E. M. Crowther in February 1953; by members of the Royal Commission on Land and Population in East Africa, in May 1953; and by Mr. J. C. May, and Mrs. May, arriving on 31st December 1953.

Messrs. MacDonald, Geering, Farbrother and Le Mare from Namulonge paid a brief visit to Ukiriguru in May 1953, to discuss work and results. There were numerous other visitors, including parties of chiefs, headmen, and instructors. The Ukiriguru Station is very much a demonstration centre for Sukumaland and the East Lake area. The Lake Province Cotton Committee have built—to house visiting courses —two dormitories, a dining-hall cum classroom, kitchen, latrines and bathrooms.

Lake Province Cotton.

1952-53 was probably the worst season experienced in the Lake Province in the twenty-two years that records have been kept at Ukiriguru; and from reports, one of the worst for half a century. In the circumstances the cotton production of 38,221 bales is considered satisfactory. The acreage planted was reported as approximately half that of the previous season. Much of the cotton was late planted.

At Ukiriguru, yields in the variety trials, under conditions of fairly good fertility, were amongst the highest that we have recorded. In the Exhaustion Plot, continuously cropped under cotton for twelve years, the yield, the highest in the twelve years, was 922 lb. seed cotton/acre (compared with 326 lb./acre the previous season, and a mean for the twelve years of 505 lb./acre). In the Lake Province Cotton Committee district fertiliser tests—to be referred to later—the mean control yield was 794 lb. seed cotton/acre. At Lubaga cotton yields were poor to only fair.

In general there was little American bollworm damage; the patchy early planting rains had made difficult any early establishment of maize.

On Ukiriguru very considerable American bollworm populations were attracted to bulk maize in mid-May, while the cotton escaped attack. Bacterial blight loss was generally unimportant. It was the lightest attack in the last nine seasons, though some district reports of blight damage were received. [In seven of these seasons, bacterial blight caused either severe or very severe loss in the cotton crop.]

1953-54 Cotton Planting. The 1953-54 season has started well. Rains to the end of January—though in some areas on the light side—have been fairly well distributed. It is reported that the cotton acreage may be a record. Stands are reported as good. Nearly half the seed issue was dusted with Perenox. There has been a drive for rotation.

Approximately 150 tons of Uk51 have been distributed to growers in the Buchosa zone, and approximately 2,700 lb. of Uk53 have been distributed to 169 growers in Kome Island. The Shinyanga District has been planted with Uk46; the rest of the Province is under Uk48.

Bacterial blight loss may be anticipated, especially in the areas using undusted seed, and where rotation has not been practised; and the chances of American bollworm damage have to be faced. There have been considerable plantings of early maize to provide much-needed early food. On the first of these plantings, tasselling at the time of writing (early February), there are American bollworm larval populations.

Summary of the Main Results and Progress.

Compared with continuous cultivation, an increase in cotton yields following "tumbledown" and planted fallows is again recorded in the first and second cropping years. The "tumbledown" fallows have given increases equal to, or greater than, the planted fallows; they were similar to the increases obtained from the compost or phosphate dressings applied to treatments continuously cropped.

In the now nearly classical Trial (8), residual responses to the 7 tons/acre dressing of FYM applied in 1944 were still over 200 lb. seed cotton/acre; the residual responses to the lower dressing of FYM, and to the compost dressings, were not significant. There was still a very large residual increase—over 400 lb. seed cotton/acre—from the heavy cotton seed ash dressing.

The manurial and fertiliser responses in general were similar to other years, with somewhat smaller responses to phosphate. Top-dressing with sulphate of ammonia gave good responses in some trials, with no significant response in others. The Lake Province Cotton Committee district fertiliser tests, carried out on a considerable number of African shambas in the Mwanza area, showed worthwhile responses to the application of phosphate, and to top-dressing with sulphate of ammonia.

At Ukiriguru the cotton responses to ridge-tying were good. At Lubaga, in two experiments, both cotton and sorghum showed large increases when grown on tied ridges compared with flat cultivation.

Uk53 was constituted and issued for first multiplication.

The important crossing programme with Albar 51 continues, breeding for resistance to bacterial blight.

There was a marked reduction in early bacterial blight infection following seed dusting; but there were no yield differences. It was a year of very mild bacterial blight attack.

At Ukiriguru, in early May considerable American bollworm egg-laying occurred on bulk maize. Cotton escaped attack; the maize had acted as a trap.

General Account of the Work for the Season.

Husbandry.

Land Resting.—Of the four original resting crop trials, Trials (1) and (2) were carrying their 9th indicator crop, and Trials (3) and (4) their 7th indicator crop. They are now being discontinued. There were still this past season suggestions of residual responses to the various resting treatments, but none was significant. In Trial (1), however, the manure—5 tons/acre FYM—applied at the digging in of the millet control and the elephant grass rest in 1944, still showed a significant increase of 150 lb. seed cotton per acre over the unmanured control.

Table 1.

Resting Crop Trial.

Ukiriguru—Hill Sand—Trial (5).

6 blocks of 14 plots (7 cotton: 7 millet) of 1/35·6 acres. 5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 9th December 1952 (cotton); 8th January 1953 (millet). Cropping rotation—2 years cotton: 2 years millet. The plots are rotated every second year and in any one year half the plots are under cotton and half are under millet.

Three Years' Treatments, 1948-49 to 1950-51.	*Second Indicator Crops.*			
	Cotton.		*Bulrush Millet.*	
	Seed cotton lb./acre.		*Grain lb./acre.*	
Annual cropping, residues carried off ...	822	100%	632	100%
Annual cropping, residues grazed ...	929	113	667	106
Cassava, weeded first year only	969	118	876	139
"Tumbledown" fallow—grazed	1049	128	801	127
Planted grass fallow—not grazed ...	951	116	732	116
Planted grass fallow—grazed	1061	129	854	135
Planted grass fallow—undersown with *Tephrosia* and *Crotalaria*—grazed ...	985	120	812	128
Sign. Diff. (P = ·05)	105	13%	121	19%
S.E.	± 36·5		± 41·8	

In Trial (5), Table 1, cotton and millet were second indicator crops. The benefits from the fallow rests were not so great as last year, and there was little difference between "tumbledown" and the planted

fallows. Grazed treatments showed up slightly better this year than ungrazed.

TABLE 2.
RESTING CROP TRIAL.
Ukiriguru—Hill Sand—Trial (7).

12 blocks (6 cotton: 6 bulrush millet) of 8 plots of 1/48·4 acres. 5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 12th December 1952 (cotton); 7th January 1953 (millet). Cropping rotation—2 years cotton: 2 years millet.

Five Years' Treatments, 1947-48 to 1951-52.	*First Indicator Crops.*			
	Cotton.		*Bulrush Millet.*	
	Seed cotton lb./acre.		*Grain lb./acre.*	
Annual cropping—no manure	1185	100%	1000	100%
Annual cropping—double superphosphate at 200 lb./acre applied 1952-53. Soda phosphate totalling 600 lb./acre applied in 1946-47, and 1947-48 ...	1729	146	1207	121
Annual cropping—Compost at 6 tons/acre applied 1952-53. Farm yard manure totalling 7½ tons/acre applied in 1946-47, and 1947-48	1704	144	1472	147
"Tumbledown" fallow—grazed	1770	149	1251	125
"Tumbledown" fallow—not grazed ...	1733	146	1034	103
Planted fallow—grazed	1501	127	1132	113
Planted fallow undersown with *Tephrosia* and *Crotalaria*—grazed	1658	140	1304	130
Planted fallow undersown with local creeping legumes—grazed	1662	140	1111	111
Sign. Diff. (P = ·05)	147	12%	152	15%
S.E.	± 51·1		± 52·9	

Trial (7), Table 2, gives the first results from a similar trial started in 1947/48, with the resting treatments down for five seasons. In the cotton portion, the yields after the "tumbledown" fallows are similar to the yields from the continuously cropped plots which had received compost and phosphate dressings. With cotton, the yields from the "tumbledown" fallows are slightly greater than from the planted fallows. Undersowing of legumes in the planted fallows has resulted in some increase. The story is not so clear-cut in the millet portion of the trial. As has been shown in earlier experiments, cotton and millet differ in their responses to treatments. The best responses in the millet portion of the trial were from the treatments where some nitrogen would have been added—the compost dressed plots and the grazed rests, especially those undersown with *Tephrosia* and *Crotalaria*. The local creeping legumes were not a success.

It is possible that the response to the "tumbledown" rest may be largely a *Tridax repens* story, as has been mentioned in previous reports. It is hoped that this, and the other fertility problems, will be clarified with the start of Mr. Le Mare's work on the chemical side of these Ukiriguru fertility experiments.

It has been seen that on the hill sand soils, land resting results in increased yields. It is quite likely that, in these densely populated areas such as around Ukiriguru, the occasional "tumbledown" rests on the hill sands, in years when circumstances prevent full cultivation, are important influences in maintaining productivity, and thus the population on the land. On the other hand on a station where a range of continuing experiments on exhausted land is desired, it is something of an embarrassment when land intended for such experiments years hence has to be cropped annually merely to keep it exhausted.

At Lubaga, early growth of cotton following a *Cenchrus ciliaris* grass rest was markedly better than in the plots with continuous cultivation, but there was no increase in final yield.

Another Lubaga trial showed a profit in the second cropping year following *Cenchrus* rest, but yields in this trial were very poor. The yield of cotton was depressed following *Chloris gayana*; in this treatment termites were very active, and stands consequently poor.

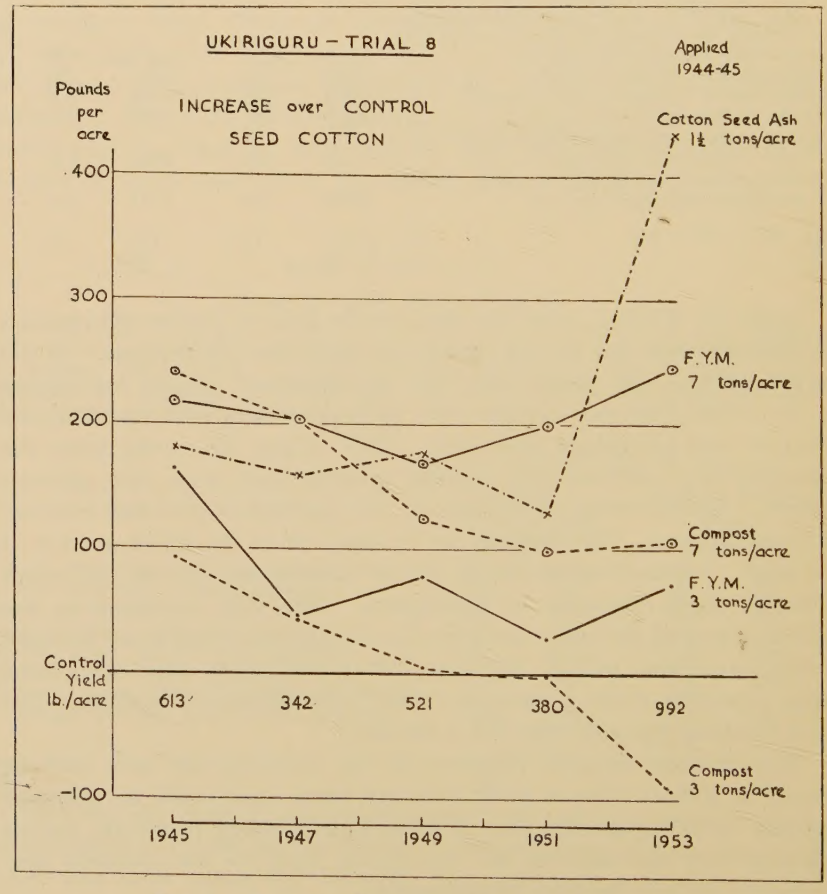


Fig. 1. Residual Effects of Organic Manures

Manuring and Fertilisers.—In Table 3 are set out the results from Trial (8), where residual responses are measured from organic manurial and cotton seed ash dressings applied in late 1944. The results in the five seasons when cotton has been the indicator crop are shown in Fig. 1. The results this past season were from the 9th indicator crop, cotton; in this trial cotton and millet are grown in alternate years. The 7 tons/acre FYM dressing was still showing over 200 lb. seed cotton/acre (24%) increase over control. This is as high a yield response with cotton as has been obtained in the 9 years. The residual responses from the heavier compost dressing, and the lower FYM dressing, were not significant; the effect of the lower compost dressing had disappeared.

TABLE 3.

MANURIAL TRIAL.

Ukiriguru—Hill Sand—Trial (8).

8 blocks of 6 plots manured in November 1944. Half-plots, each 1/35·6 acres, were manured at the same rates in November 1952, or received sulphate of ammonia at 175 lb./acre in March 1953.

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 19th November 1952.

Treatments.	*Yield seed cotton lb./acre.*		
	Ninth indicator crop.	*First indicator crop.*	
	Treatments applied 1944.	*Treatments re-applied* 1952.	*Sulphate of Ammonia applied* 1953.
Control—no manure .	992	—	882
Compost—3 tons/acre .	900	1151	—
Farm Yard Manure—3 tons/acre ...	1065	1189	—
Compost—7 tons/acre	1098	1362	—
Farm Yard Manure—7 tons/acre ...	1237	1537	—
Cotton Seed Ash—1½ tons/acre ...	1424	—	1604
S.E.	±55·0	±57·2	
Sign. Diff. (P=·05) ...	158	164	
Between treatments— in the same line ...	131		
not in the same line or column	165		

Interaction: Ash × Nitrogen ... +145 lb./acre.
S.E. ... ... ±45·6 lb./acre

The striking residual response, an increase of over 400 lb. seed cotton/acre (43%), was from the plots dressed with cotton seed ash. [This cotton seed ash was reported to contain about 15%-20% P_2O_5. The dressing was a very much heavier phosphatic application than had been intended.] Till this season the cotton responses to this ash dressing had been of the same general order as to the heavier FYM and compost dressings. No theory can be offered why this season the

residual response to ash should be so large. Reviewing the responses in this trial over the years cotton has shown higher residual responses to the ash than has millet.

Half of each of the organic treatment plots had the dressings reapplied this past season. The results are shown in Table 3. The reapplication of 7 tons/acre FYM resulted in a large increase over control, over 500 lb. seed cotton/acre, 300 lb. additional to the residual effects from the original manuring.

Sulphate of ammonia, at 175 lb./acre, was applied to one half of each of the control and ash plots. Sulphate of ammonia had no significant effect on the control plots, but increased the yields from the ash plots by nearly 200 lb. seed cotton/acre.

In Trial (9), Table 4 (Table 2, 1951-52 report) second residual responses were measured. The residual responses from the compost and phosphate dressings, and the response to the reapplied nitrogen, were of the usual order. There was no residual response from the nitrogen applied in 1952.

TABLE 4.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (9).

2×3×2 factorial, with NPD and ND interactions partially confounded, testing all combinations of:—

n_0, n_1,	...	0, 175 lb. sulphate of ammonia/acre.
d_0, d_1,	...	0, 6 tons compost/acre.
p_0, p_1, p_2,	...	0, 45, 90 lb. triple supers/acre.

6 replications in 12 blocks of 6 plots, each 1/69·7 acres. Compost and phosphate applied 6th-8th December 1950; nitrogen applied 19th-20th March 1951, 12th and 28th March 1952, and 7th March 1953. 5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 1st December 1952.

SECOND RESIDUAL YEAR—NITROGEN RE-APPLIED.

Mean yields: Seed cotton lb./acre.

	n_0	1366	p_0	1370	d_0	1366
	n_1	1568	p_1	1486	d_1	1568
			p_2	1545		
Sign. Diff. (P = ·05)		84		103		84
S.E.		± 29·5		± 36·2		± 29·5
Interactions.						
	NP_2	+ 30	P_2D	− 72	ND	0
S.E.		± 51·2		± 51·2		−

In Trial (23), where the direct response to phosphate last year was nil, this season, in the second indicator crop, there was no residual response to the phosphate. There were small residual organic responses; slight increases due to the application of sulphate of

ammonia at different times were not significant. This trial is being discontinued. The general area is one of old house sites, and it is felt that the lack of response to manuring treatments has been due to this.

In a new trial laid down on poorish soil, Trial (26), the treatments, 150 lb./acre triple superphosphate, and 6 tons/acre compost, resulted in similar yield increases, about 200 lb. seed cotton/acre, control 994 lb./acre; the combined phosphate-compost dressings together were little better than the separate applications. The top dressings of sulphate of ammonia, 175 lb./acre, applied at three different times, had no significant effects on yield.

This lack of response to sulphate of ammonia is also noted in the Trial (23) results mentioned earlier, and in the results from the top-dressing to the heavily manured portion of the Exhaustion Plot, referred to later. Positive increases were obtained in Trial (9), where there was a considerable increase from the top-dressing, and in the Lake Province Cotton Committee tests in the Bukumbi and Mwanza chiefdoms, referred to later.

Half of the Exhaustion Plot, growing the 12th continuous cotton crop for demonstration purposes, had had in 1951-52 very favourable treatment, 10 tons/acre compost, plus two top-dressings amounting to a total of 250 lb./acre sulphate of ammonia. The first residual yield from this area, this 1952-53 season, was 1,297 lb. seed cotton/acre, compared with 922 lb./acre from the untreated half of the original plot —now, in fact, the Exhaustion Plot. No increase in the treated half was recorded from a further top-dressing of 175 lb./acre sulphate of ammonia.

A very interesting set of results was obtained in a series of tests carried out by the Lake Province Cotton Committee, applying superphosphate and sulphate of ammonia to African holdings in hill sand areas around Mwanza. Ukiriguru has been associated with the work throughout, particularly in analysing the results obtained. The trials were supervised by staff comparatively untrained in such work. It was a first attempt at an extensive test of this kind, and many of the fields were not as uniform as was desirable. The results are remarkably consistent; they are statistically significant. Yields were good for African grown cotton in the heavily cropped soils of the areas. Owners of the plots may have given them better attention than usual, and all the plots used in the analysis were tie-ridged. Further, the sample areas recorded (20′ × 20′ for each treatment) were selected for good average growth and stand. 90 lb./acre double superphosphate were applied to just over 3,000 shambas; and of these just over 1,350 shambas had a portion of the phosphate area top-dressed with sulphate of ammonia, 200 lb./acre. A large number of fields were discarded for various reasons. A total of 554 shambas was recorded; 317 in the Mwanza chiefdom, 237 in the Bukumbi chiefdom.

Over all the tests the mean increase was 145 lb. seed cotton/acre from the superphosphate application, with an additional 206 lb./acre where sulphate of ammonia was top-dressed on the phosphated area. From Ukiriguru experience, there should be two to three years residual benefit from the phosphate, but no residual benefit from the sulphate of ammonia. The cost of fertiliser applied would be approximately Shs. 40/-/acre for the superphosphate, and Shs. 55/-/acre for the sulphate of ammonia.

The selling price of seed cotton for the 1952-53 season was 50 cents (6d.) a pound, 48 cents to the grower and a cess of 2 cents to the native authorities.

Using the mean control yield in each "gunguli" (a small administrative unit) as a measure of fertility, there are indications that the response to phosphate was less with higher fertility and the response to nitrogen greater.

		Yields in seed cotton in lb./acre.					
		No. of Holdings.	*Control.*	*P*	*NP*	*Sign. Diff.*	*S.E.*
All trials	...	554	794	939	1145	25	±9·0
		Holdings grouped in Chiefdoms.					
Chiefdom.							
Mwanza	...	317	860	1019	1272	35	±12·5
Bukumbi	...	237	706	831	974	33	±11·9

In 1953-54 residual responses are to be measured on just over a hundred holdings. Fresh applications are being made in a new series of trials.

Spacing and Time of Planting.—In two trials, one on rich land and one on poorer land, different spacings, times of planting, and times of application of nitrogen were compared. The times of planting—as so often must happen in practice—were unevenly spaced because of dry weather. The first two plantings, early December and early January, gave much the same yields; but there was a very big drop with the March plantings. Wide spacing throughout gave a poorer yield than the closer normal spacing. The top-dressing of sulphate of ammonia, 175 lb./acre, gave a small but consistent increase in yield.

Ridging and Tying.—There are occasions when there is no immediate profit from ridging and tying, measured in increased yields, as distinct from the general story of preventing soil loss; and in a very wet year on certain soils for some crops, there may even be the suggestion of a yield depression. But this past season the benefits from ridge-tying were very apparent. At Ukiriguru the profit was much greater for cotton than for bulrush millet. Being a longer term crop,

it benefits more from the holding of the rains of November, December and January. In the cotton section of the main ridging trial, Trial (16), the good ridges tied gave 355 lb./acre more seed cotton than the poor ridges not tied –a 48% increase. In the bulrush millet section the increase was 100 lb./acre, only 10%.

Table 5.

Ridging Trial.

Ukiriguru—Hill Sand—Trial (16).

10 blocks (5 cotton : 5 bulrush millet) of 4 plots (ABBA arrangement) each 1/29·0 acres. 5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 24th November 1952 (cotton); 12th January 1953 (bulrush millet). Cropping rotation—alternate cotton and bulrush millet.

Treatments.	*7th Year of Treatments.*			
	Cotton.		*Bulrush Millet.*	
	Seed cotton lb./acre.		*Grain lb./acre.*	
Poor ridges—not tied	748 =	100%	1018 =	100%
Good ridges—tied	1103	148	1119	110
Sign. Diff. (P = ·05)	119	16%	100	10%
S.E.	± 37·1		± 31·2	

In a second trial, Trial (15), this season under bulrush millet, there was again about a 10% increase from the tying (not quite significant).

At Lubaga in the "ibambasi", cemented hard soil, experiment, where striking results have been obtained in many years, cultivation on tied ridges gave around double the crop, both cotton and sorghum, compared with cultivation on the flat—in spite of much poorer stands on the 4 ft. ridges. There was no difference in yield between 3 ft. and 4 ft. ridges. The cotton yields were low.

Table 6.

Ridging Trial.

Lubaga "Ibambasi" Soil.

12 blocks (6 cotton : 6 sorghum) of 3 plots of approx. 1/8·3 acres. 3 foot rows at 12″ spacing; 4 foot rows at 9″ spacing. 1 row per ridge, 2 plants per hole. Planted 21st-23rd January 1953. Cropping rotation—alternate cotton and sorghum.

Treatments.	*10th Year of Treatments.*			
	Cotton.		*Dobbs Sorghum.*	
	Seed cotton lb./acre.		*Grain lb./acre.*	
3 foot—flat cultivation	233 =	100%	911 =	100%
3 foot ridges—tied	464	199	2154	236
4 foot ridges—tied	375	161	2118	232
Sign. Diff. (P = ·05)	129	55%	461	51%
S.E.	± 41		± 146	

In a second trial at Lubaga, on "ibushi", the old lake bed black loam soil, under Dobbs sorghum, the increases from the ridge tying compared with flat cultivation were large. There was, in this experiment, no advantage from ridging without tying.

TABLE 7.

RIDGING TRIAL.

Lubaga "Ibushi" Soil.

6 blocks of 5 plots of 1/29·0 acres laid down in 1948-49. One row per ridge: spacing 12″ in 3 foot rows, 7″ in 5 foot rows. Planted 27th November 1952.

Treatments.	*Dobbs Sorghum.*	
	Grain lb./acre.	
Flat cultivation—3 foot rows	647	= 100%
3 foot ridges—not tied	589	91
3 foot ridges—tied	1210	187
5 foot ridges—not tied	441	68
5 foot ridges—tied	1494	231
Sign. Diff. (P. = ·05)	315	49%
S.E.	±107	

The profit from ridge-tying in such a year, balanced against the extra labour involved in tying and ridging, should have been apparent even to the most indifferent cultivator.

Rotation.—Last year at Ukiriguru, in Rotation Trial (19), an increase of over 40% was recorded where cotton followed two years of bulrush millet, compared with continuous cotton or cotton with only one year of millet in between. The suggestion made was that this "rotational" benefit might be due to a reduction in bacterial blight trash carry-over by having a gap of two years between cotton crops. This season, with yields of cotton around 900 lb. seed cotton/acre, and bulrush millet around 700 lb./acre, there were no significant differences between any of the rotational treatments. With little bacterial blight and little infection from trash, big differences due to bacterial blight trash infection would not have been expected.

In a similar trial at Lubaga, the yield of sorghum following sorghum was significantly greater than the yield of sorghum following cotton, and cotton following sorghum was possibly better, certainly not poorer, than cotton following cotton in the rotation.

General.—On the granitic red hill soils, such as round Ukiriguru, productivity could be raised fairly simply in a number of ways—by resting land, by using organic manures, or by applying fertilisers; and in most years there is profit in ridge-tying.

On the Lubaga black loam soil there is little response to manuring. There may be some benefit from land resting; but not to the extent that there is at Ukiriguru. At Lubaga, especially in seasons of patchy rain, the greatest contribution to increased productivity lies in ridge-tying.

Cotton Breeding.

Uk53 was constituted and issued for first multiplication—approximately 2,700 lb. for growing by 169 growers. It consisted of 45% of 8/290 and strains of 8/290 origin; 35% of strains of 5/57 origin; and 20% of strains of 7/150 and 6/318 origin.

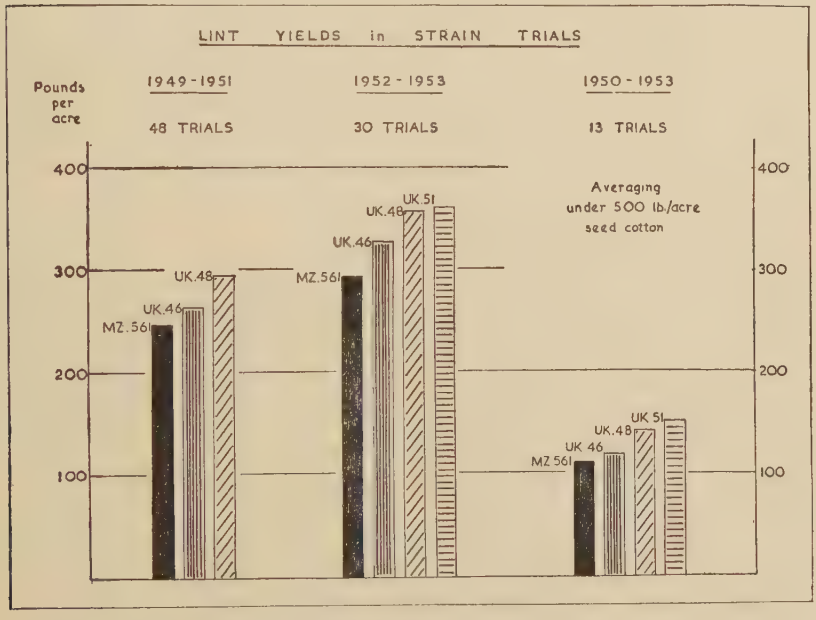


Fig. 2. Lint Yields in Strain Trials — 1949-53

In Fig. 2 the lint yields over five seasons are illustrated, from 78 valid strain trials, including the main trials at Ukiriguru and Lubaga, and a scatter of district plot trials throughout the Province, comparing Mz561, Uk46 and Uk48; and over two seasons from 30 valid trials, comparing Uk51 with the earlier issues. Lint yields are shown for three seasons from 13 of these trials where seed cotton yields were averaging under 500 lb./acre. Taking the 1949/51 series of trials, Uk46 was up 7%, and Uk48 up 21% on Mz561. Taking the 1952/53 series of trials,

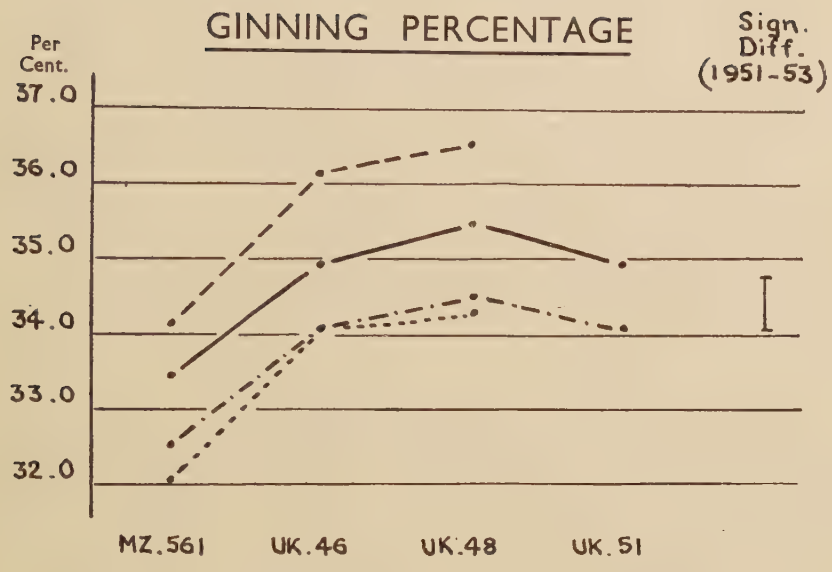
Uk46 was up 11%, and Uk48 up 22% on Mz561, with Uk51 yielding about the same as Uk48. The yield level over the 78 trials was good. Taking the low yielding series of trials, the relative increases are of the same general order, but rather better; 28% up for Uk48, and slightly better for Uk51. [The largest yield differences were in 1952, when, for example, in the main Station trials Uk48 was 40% up on Mz561, 16% up on Uk46, with Uk51 yielding slightly better than Uk48.]

The two Ukiriguru hill sand strain trials this past season yielded at a high level, the mean control yields being 1,900 lb. seed cotton/acre. Mz561 was 13% down in lint yield on Uk46 in the one trial where Mz561 was included. There were no differences in yield between Uk46, Uk48 and Uk51 in either trial; and in both trials there were only a few significant strain differences compared with Uk46, the control. Some 7/150 segregate strains were significantly poorer than Uk46 in both trials. In the Lubaga strain trial yielding at the 700 lb. seed cotton/acre level, there were no significant yield increases over the control, Uk46. No theory can be offered why there should be such small yield differences this season. The Ukiriguru "mbuga" trial was too uneven after repeated re-plantings to allow the comparative yields to be measured.

District plot yields as a whole were variable and not particularly good. Two plots could not be planted for lack of rain; one was practically a failure; four were cropping at around 300-350 lb. seed cotton/acre; two at around 750 lb. seed cotton/acre; one at around 850 lb. seed cotton/acre; five at around 1,000 lb. seed cotton/acre, and one at 1,350 lb. seed cotton/acre. Uk48 averaged 9% up on Mz561 in lint yields; the highest increase on Mz561 was 15%. The best yielding strains were 7/9 and 7/14 ex 5/57, and 8/290.

There were reports of scattered minor jassid damage; but jassid was not a factor influencing any of these trial yields.

Ginning Percentage; Seed Weight.—Fig. 3 shows ginning percentage and seed weight variations for the past four seasons, and gives a comparison of ginning percentages and seed weights between Mz561, Uk46, Uk48 and Uk51 from replicated trials. The story is generally consistent, with Uk46 around 1·5% higher in ginning percentage than Mz561, sometimes more; Uk48 around 0·5% better still; and with Uk51 giving about the same ginning percentage as Uk46. The variations from season to season are important administratively; they can be partly, but not wholly, linked with variations in seed weight. Variations also occur between ginnery zones in the same season, not following a consistent pattern, nor explained only by variations in seed weight.



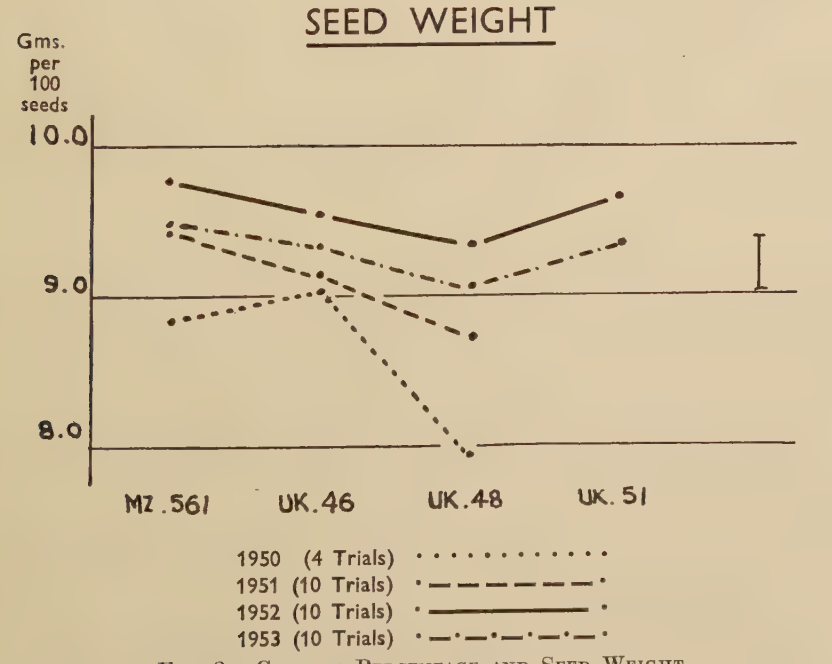


FIG. 3. GINNING PERCENTAGE AND SEED WEIGHT

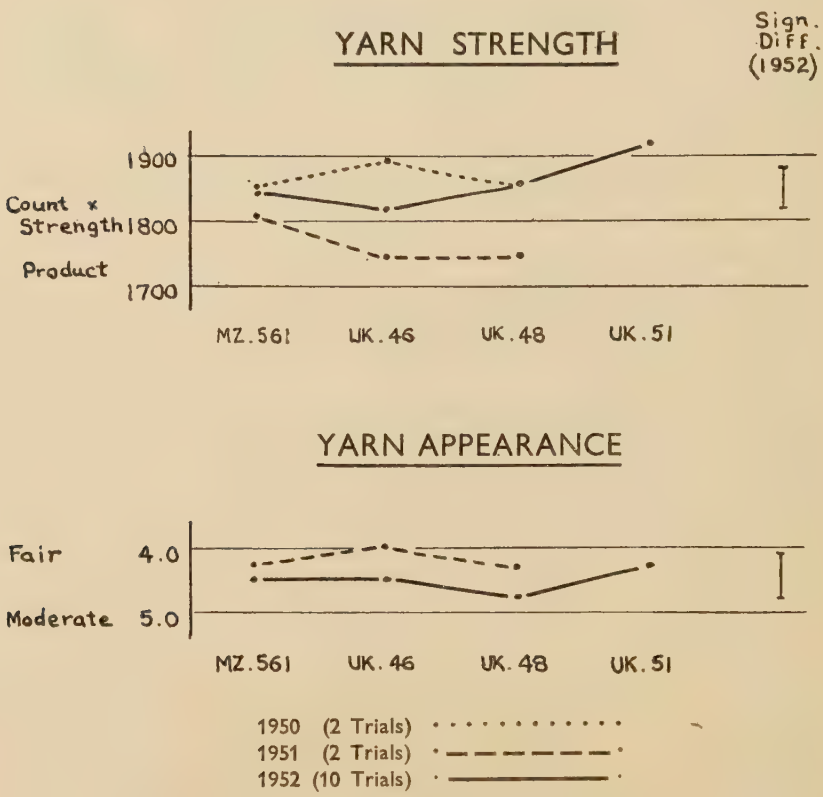


Fig. 4. Yarn Strength and Appearance

Spinning Tests and Yarn Appearance Reports. Fig. 4 illustrates the Shirley Institute count × strength product results for three seasons, for Mz561, Uk46, Uk48, and Uk51; and yarn appearance gradings for two seasons. The results are from replicated trial material from large and small scale spinning tests.

As always, we are very greatly indebted to the Shirley Institute for these spinning tests and reports.

It will be seen that the spinning qualities of the several seed issues remain similar; but that there is the suggestion of slight improvement in the quality of Uk51.

We await with great interest Mr. Evenson's further experimental testing of a range of our material at Namulonge—more particularly the grading for percentage of seed coat damage, and chalazal tuft immaturity grading, linking up—possibly anticipating and explaining—variations in spinning qualities.

Crossing Programme with Albar 51.—The crossing programme with Albar 51 continues to be the most important part of the breeding programme. It is turning out less straightforward than we had, perhaps rather optimistically, hoped. We are still assessing defects and qualities in the Ukiriguru material, more particularly in spinning and yarn appearance. The qualities of the Albar 51 segregates are still comparatively unknown. But the adding of bacterial blight resistance to Ukiriguru stocks is of such importance that it seems worthwhile continuing a large crossing programme, anticipating a considerable amount of discarding, rather than waiting for a more exact appreciation of the qualities of the Albar segregates before starting work.

Both in the Albar 51 segregates and in the new hybrid progenies, a considerable proportion of "unbalanced" types have been showing up. Such plants wilt at any stage from young plants to fairly mature plants with opening bolls, and, if left, eventually die. The defect appears to be physiological.

First and second back cross progenies are now growing, and selfed lines from the most promising hybrid material.

Selection for bacterial blight resistance is based on reaction to (a) seed inoculation and (b) stem inoculation, using Wickens' needle prick technique.

The most promising material is grown out of season with hand watering, planting in June-July and picking in November-December, thus gaining an extra generation.

Diseases and Pests.

Diseases.

Bacterial Blight (*Xanthomonas malvacearum*).—Observations on the severity of bacterial blight over the past nine seasons show that damage caused by the disease last season was the lightest recorded. There was a light attack in 1948-49, but in the remaining seven seasons the general attack ranged from severe to very severe. Both light attacks have occurred in seasons of exceptionally low and unevenly distributed rainfall.

In spite of the lack of damage to the crop caused by bacterial blight, the disease was of universal occurrence. Most plants showed some angular leaf spot and small restricted lesions on stems, branches, and peduncles. Boll infection was at a high level and was particularly noticeable towards the end of the season. The most frequent point of infection was at the base of the boll, causing yellow staining of the points of the locules.

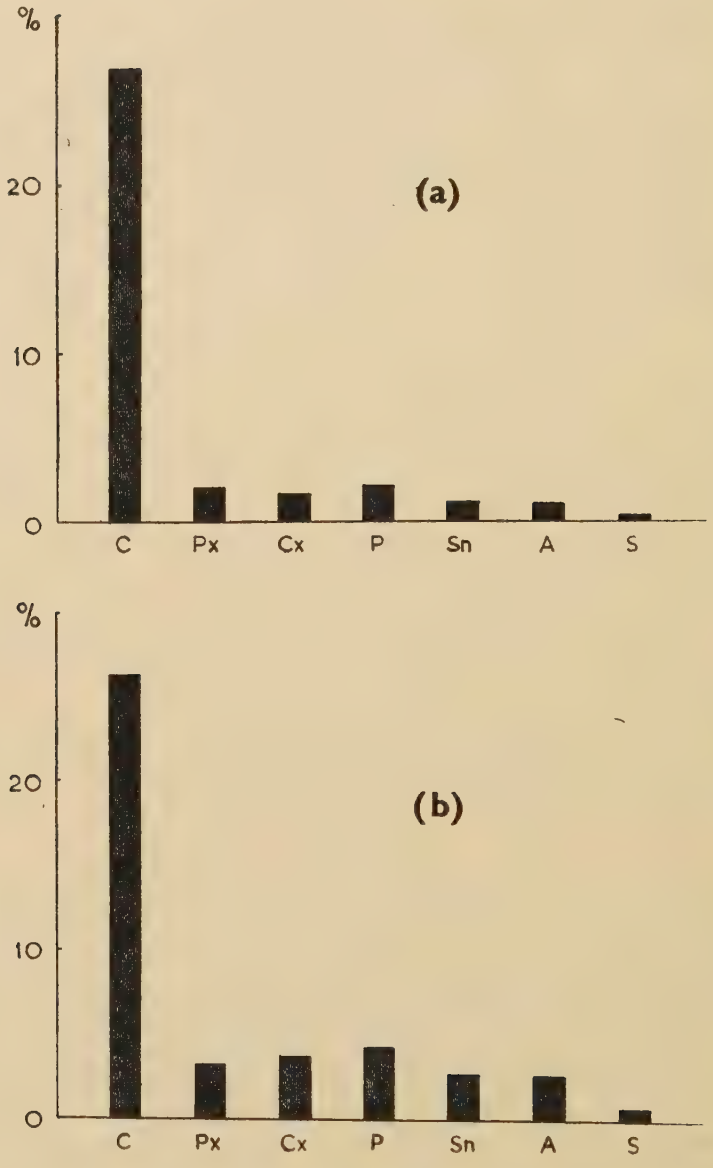


FIG. 5. CONTROL OF BACTERIAL BLIGHT BY SEED TREATMENT.

(a) Percentage of seedlings showing cotyledon lesions at 3-4 weeks after emergence.

(b) Percentage of thinnings showing stem lesions at 6-7 weeks after emergence.

The seed was naturally infected, fuzzy seed (Uk46). Dusts were applied at the rate of 1 : 300 w/w. Treatment with sulphuric acid was carried out in the normal way. Mean number of plants scored per treatment:—(a) 1,146; (b) 298. C—control, untreated; Px—Perenox; Cx—Cupromax; P—Perecot; Sn—Spergon; A—Agrosan; S—Sulphuric acid.

In a trial at Ukiriguru, to investigate the control of seedling infection by chemical seed treatment, a marked reduction in the early stages of infection was observed following treatment with a range of chemicals. Some of the results are shown in Fig. 5. The data summarized in diagram (a) were transformed for analysis using the function $y = \log(x + c)$. The analysis showed that sulphuric acid treatment was more effective than treatment with Perenox ($p < \cdot 05$); the observed improvement of Spergon and Agrosan over Perenox approached significance at the 5% level. The comparison between control and treatments was highly significant in all cases. Diagram (b) is based on data obtained from thinnings. The plots were thinned by labourers in the normal way and there may have been some bias towards removing the worst plants.

Later observations showed that the early control of bacterial blight gradually disappeared as infection spread through the plots and across the guard rows. The trial was planted on land which had carried cotton in the previous season, and it is possible that there was infection from trash.

The experiment, though not designed to measure yields, was harvested as a yield trial. At the first picking, the treatments outyielded the controls by a mean level of 25% ($p < \cdot 05$). The total yields, however, were irregular. Yields of individual treatments were not correlated with the degree of bacterial blight infection recorded at the seedling stage, and the final mean yield of the treatments was not significantly above that of the controls. (The trial consisted of twelve seed treatments and two controls, in randomized blocks, eight replications).

It was also possible to observe the effects of seed treatment with Perenox under conditions of native cultivation. Two hundred tons of seed, which had been treated in Uganda, were planted in part of Mwanza district, chiefly on rotated fields. The boundary between the zones of treated and untreated seed passed through the area covered by the Lake Province Cotton Committee fertiliser experiment. Yield figures were taken from 150 treated plots and 107 untreated plots in one area, where climatic and soil conditions were similar. From these figures no increases in yield due to the seed treatment could be detected. Similar observations are to be made in the coming season; the indications at the time of writing are that the damage caused by bacterial blight will be greater than that observed last season.

Wilt Disease.—A wilt disease was again observed at Lubaga in cotton growing on land which had been under grass for the previous three years. Affected plants showed severe wilt symptoms and brown staining of the vascular strands. The pathogen has not yet been identified.

Pests.

American Bollworm.—American bollworm damage was small, though there were reports of loss in some areas. At Ukiriguru there were American bollworms on ensilage maize in mid-March; and at that time bollworms were also reported in native maize crops adjacent to Ukiriguru. There was a very small American bollworm attack on cotton at the end of April. In mid-May very considerable populations were recorded on a field of bulk maize, but there was very little attack then on cotton, even nearby cotton. The maize had attracted the egg-laying moths. Populations of the same order on cotton as on the bulk maize would considerably have reduced Ukiriguru yields. [In the 1953-54 season maize plantings have been planned, to try to give, as far as rains permit, a succession of cover from tasselling maize.]

A very interesting observation recorded by the Botanist on sorghum has been that American bollworms are very frequently found in heads bagged for selfing. But only very occasional larvae are found on unbagged heads of the open-panicled types; some are found on tighter panicles. Insectivorous birds may be destroying the larvae on the open panicles. Unfortunately, at least in parts of the Province, the activities of grain-eating birds may make it difficult to grow open-panicled palatable early sorghum types, which might well act as traps for the early American bollworm generations.

Spiny Bollworm.—A few spiny bollworms were reported on Ukiriguru; and there were reports of early scattered damage by spiny bollworms in the districts.

Pink Bollworm.—Occasional pink bollworms were reported at Ukiriguru towards the end of May. None was observed in the out-of-season crossing material until the end of January 1954, when a few specimens were found. As soon as these were discovered the remaining plants were uprooted, and all trash was burned.

Stainers.—At Ukiriguru stainers were observed in cotton by early March—mainly *D. superstitiosus.* Numbers increased through the season; by late June there were fair populations, mainly *D. fasciatus.* There were fair *Calidea* populations in and out of the crop in May and June.

In out-of-season planting, populations built up in mid to late November 1953, mainly *D. fasciatus* with some *D. nigrofasciatus.* At the end of November the plants were dusted with Toxaphene. Later, after a further build-up of *D. fasciatus* and nymphs, plants were again dusted.

At Lubaga and in the Shinyanga district plots, where in many years stainer damage is the most important factor affecting the cotton crop, stainer damage this season was severe. At Lubaga from March

onwards, there were considerable populations, mainly *D. fasciatus,* breeding in the crop. The first picking at Lubaga showed 30% Grade C; for the whole picking the percentage of Grade C was 40%-50%. The Shinyanga district plots showed an even higher percentage of Grade C, around 60%. It is hoped that arsenic and sugar poisoning can be tested more thoroughly in the 1953-54 season.

At Ukiriguru the percentage of Grade C varied around 10%-15%. The percentages from the district plots, in the Lake shore area and middle interior, were generally under 10%. In these areas—including Ukiriguru—possibly there has not been sufficient emphasis on the influence of the bollrot phase of bacterial blight on the amount of Grade C cotton. It would be fairly safe to say, however, that in Southern Sukumaland the predominant influence is stainer and *Calidea* damage.

Appendix.

Origin and Special Characteristics of the Main Cotton Strains Mentioned.

Lake Province "Local"	The commercial cotton in the Province prior to the issue of Mz561—mainly of Uganda Local origin.
Mz561	A straight selection from "Local", first multiplied in the 1939-40 season.
Uk46	A seed issue with fair jassid resistance, made up of the four best Ukiriguru strains and the three best Lubaga strains available at the time, first multiplied in the 1946-47 season.
Uk48	A seed issue made up of four strains of better jassid resistance than Uk46, first multiplied in the 1948-49 season.
Uk51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.
Uk53	A seed issue made up of eleven strains, first multiplied in the 1953-54 season.
5/57	A derivative of 3/17, itself a straight selection from "Local".
6/318	Ex 4/35, itself a derivative of Mz561.
6/320	Ex 4/35, cousin strain of 6/318.
7/9 and 7/14	Ex 5/57.
7/150	Ex 3/28; having high jassid resistance.
8/290	Ex 6/320; one of the heaviest cropping Ukiriguru strains.
Albar 51	General term for 1951 selections from Nigerian Allen, highly resistant to bacterial blight; ex Dr. J. B. Hutchinson.

Received March 1954.

Printed by T. Buncle & Co. Ltd., Arbroath